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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/905,398

07/14/2001

Nace Layadi

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02/11/2003

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EXAMINER

MAI, ANH D

ART UNIT

PAPER NUMBER

2814

DATE MAILED: 02/11/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/905,398

Applicant(s)

LAYADI ET AL.

Examiner

Anh D. Mai

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 November 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5,7 and 19-21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5,7 and 19-21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Amendment

1. Amendment filed November 25, 2002 has been entered as Paper No. 8. Claims 6 and 8-18 have been canceled. Claims 1-3 and 5 have been amended. Claims 19-21 have been added. Claims 1-5, 7 and 19-21 are pending.

Claim Rejections - 35 USC § 102

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claims 19 and 20 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Konecni et al., (U.S. Patent No. 6,069,072).

With respect to claim 19, Konecni teaches semiconductor structure as claimed including:

- a substrate layer;
- a dielectric layer disposed over the substrate layer and having a via formed therein;
- a polish stop layer comprising titanium nitride alloyed with carbon deposited over the dielectric layer and extending into the via;
- a metal layer deposited over the polish stop layer and filling the via; and
- wherein the polish stop layer has a hardness. (See col. 7).

Note that, the hardness which is 30 to 35 percent greater than the hardness of the titanium nitride is an inherent characteristic of the titanium nitride alloyed with carbon (TiCN) layer of Konecni.

Further, since Konecni used titanium nitride alloyed with carbon (TiCN) as a barrier layer over the via and lining the opening, therefore, the titanium nitride alloyed with carbon (TiCN) of Konecni is also function as protecting the dielectric layer from CMP process used to remove a portion of the metal layer deposited outside of the via as well.

With respect to claim 20, the percentage weight of carbon in the TiCN layer of Konecni is within the claimed range.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

3. Claims 1-5, 7 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamashita et al., (JP. Patent No. 08-107148) in view of Meikle et al., (U.S. Patent No. 5,231,306) (all cited previously).

With respect to claim 1, Yamashita teaches a semiconductor device substantially as claimed including:

a substrate (21) having a device feature formed thereon;

a dielectric layer (28) disposed over the substrate (21) and device feature and having at least one contact hole (29) formed therein;

a polish stop layer (30) disposed over the dielectric layer (28) and extending within the contact hole (29);

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a layer of metal (31) disposed over the polish stop layer (30) within the contact hole (29) and formed a plug; and

wherein the polish stop layer (30) comprises titanium nitride (TiN). (See Fig. 9).

Thus, Yamashita is shown to teach all the features of the claim with the exception of using TiAlN for the polish stop layer (30).

However, Meikle teaches that TiAlN are known in the art to be used in place of TiN in semiconductor devices.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the polish stop layer (31) of Yamashita comprises TiAlN as taught by Meikle because TiAlN material is more resistant to diffusion than TiN. (See abstract).

With respect to claim 2, the semiconductor device of Yamashita further includes a metal coating (27) under the dielectric layer (28), the metal coating (27) comprises titanium nitride. Note that, as discussed previously, in view of Meikle, metal compound of titanium nitride and aluminum (TiAlN) can be used in place of the TiN layer (27).

With respect to claim 3, the dielectric layer (28) of Yamashita comprises SiO₂.

With respect to claim 4, the metal coating (27) of Yamashita comprises an ARC.

With respect to claims 5 and 7, the barrier layer of Meikle comprises TiAlN and appears to have aluminum percentage weight as claimed.

With respect to claim 21, the claimed structure appear to be an intermediate structure. Insofar as the intermediate structure is concerned, Yamashita teaches a semiconductor device substantially as claimed including:

- a metal layer (25) disposed on a substrate (21);
- a barrier layer (27) disposed on the metal layer (25);
- a dielectric layer (28) disposed on the barrier layer (27);
- a patterned layer of photoresist disposed on the dielectric layer exposing a selected portion of the dielectric layer (28);

wherein the barrier layer (27) function as an etch stop layer. (See Fig. 6).

Thus, Yamashita is shown to teach all the features of the claim with the exception of using TiAlN for the barrier layer (27).

However, Meikle teaches that titanium aluminum nitride (TiAlN) are known in the art to be used in place of barrier layer (TiN) in semiconductor devices.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the barrier layer (27) of Yamashita comprises titanium aluminum nitride (TiAlN) as taught by Meikle because TiAlN material is more resistant to diffusion than TiN. (See abstract).

Note that, the barrier layer (27) of Yamashita, in view of Meikle, is function as an etch stop layer, thus, upon removal of the selected portion of the dielectric layer (28), the barrier layer (27) prevents the etching process from compromising the underlying metal layer.

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With respect to the patterned photoresist layer, the formation of the patterned photoresist is well known in the art. (See S. Wolf et al. *Silicon Processing for the VLSI Era*. Vol. 1, pp. 407-409).

Response to Arguments

4. Applicant's arguments with respect to all claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

5. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a).

Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

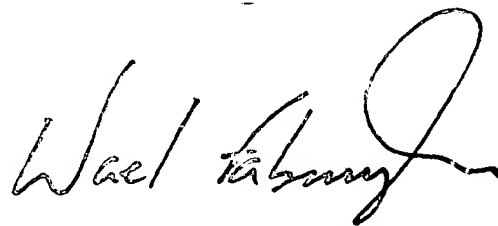
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (703) 305-0575. The examiner can normally be reached on 8:30AM-5:00PM.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703) 308-4918. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

A.M
February 5, 2003

A handwritten signature in black ink, appearing to read "Wael Fahmy". The signature is fluid and cursive, with a large loop at the end.

SUPERVISORY PRIMARY EXAMINER
TECHNOLOGY CENTER